IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re U.S. Patent Application of	)	
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YAMAZAKI et al.	)	**Art Unit: 2186**
	)	
Application Number: 10/812,893	)	
	)	
Filed: March 31, 2004	)	
	)	
For: DISK ARRAY APPARATUS AND DISK ARRAY APPARATUS CONTROLLING METHOD	)	
	)	
	)	
ATTORNEY DOCKET NO. ASAM.0118	)	

Honorable Assistant Commissioner
for Patents
Washington, D.C. 20231

PETITION TO MAKE SPECIAL UNDER 37 C.F.R. § 1.102(d)

FOR ACCELERATED EXAMINATION

Sir:

Pursuant to 37 C.F.R. § 1.102(d), Applicant respectively requests that the application be examined on the merits in conjunction with the pre-examination search results, the detailed discussion of the relevance of the results and amendments as filed concurrently.

Substantive consideration of the claims is respectfully solicited. Should there be any outstanding issues requiring discussion that would further the prosecution and allowance of the above-captioned application, the Examiner is invited to contact the Applicant's undersigned representative at the address and telephone number indicated below.

Respectfully submitted,

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STATEMENTS & PRE-EXAMINATION SEARCH REPORT
SUPPLEMENTAL TO
THE PETITION TO MAKE SPECIAL

Sir:

Pursuant to 37 C.F.R. §§ 1.102 and MPEP 708.02 VIII, Applicant hereby submits that (1) all claims of record are directed to a single invention, or if the Office determines that all the claims presented are not obviously directed to a single invention, will make an election without traverse as a prerequisite to the grant of special status; (2) a pre-examination search has been conducted according to the following field of search; (3) copies of each reference deemed most closely related to the subject matter encompassed by the claims are enclosed; and (4) a detailed discussion of the references pointing out how the claimed subject matter is patentable over the references is also enclosed herewith.

FIELD OF THE SEARCH

The field of search covered Class 711, subclass 114 (U.S. & Foreign). Additionally, a computer database search was conducted on the U.S.P.T.O. systems EAST and WEST for U.S. and foreign patents; a keyword search was conducted in Class 360, subclasses 69, 73.01, 73.03 and 74.1; and Class 713, subclasses 300, 310, 320, 321, 323, 324 and 340 (U.S. & Foreign); and a literature search was also conducted on the internet and commercial databases

for relevant non-patent documents. Examiner Reginald Bragdon in Class 711 (Art Unit 2188) was consulted in confirming the field of search.

The search was directed towards a disk array apparatus and disk array apparatus controlling method. In particular, the search was directed towards claims 1-20 of U.S. Application No. 10/812,893. Claim 1 is representative and sets forth a disk array apparatus having a plurality of hard disk drives, a controller, a disk interface, a memory, a CPU and a time counting mechanism. The apparatus further comprises an access time storage section and a power saving mode execution section. Claims 8 and 20 are similar and further define the disk array apparatus by comprising a power saving mode execution section, a power saving start time storage section and a power saving mode cancellation section.

With reference to the disclosure, FIG. 1 illustrates a data storage device 10 which receives times at which requests for data read and/or data write to/from a logical volume 83 are stored in memory 15 as access times of a RAID group 82 making up a logical volume 83. See page 13, first full paragraph. When a predetermined time has elapsed after the access time, a number of the hard disk drives according to the redundancy of the RAID group are set to a power saving mode. See page 25, second full paragraph. When the RAID group consists of only the first drives, a number of the first drives according to the redundancy of the RAID groups are set to a power saving mode and when it consists of only the second drives, and an arbitrary number of second drives are set to a power saving mode. See page 45, first full paragraph.

With reference to the claims, a disk array apparatus includes a plurality of hard disk drives, a controller, a disk interface, a memory, a CPU and a time counting mechanism. The apparatus further includes an access time storage section and a power saving mode execution section, wherein the access time storage section stores, upon reception of a request for a data read or write from a logical volume, the time acquired from the time counting mechanism as the access time in the memory in association with an identifier of a RAID group. (See Conclusion paragraph for detailed references to drawings and specification).

LIST OF RELEVANT REFERENCES

The search revealed the following U.S. patents, which are listed for convenience:

U.S. Patent Number	Inventor(s)
5,691,948	Sakabe

5,809,316	Gouzu
5,875,120	Matsushima et al.
5,918,059	Tavallaei et al.
5,937,433	Lee et al.
6,052,791	Chen et al.

U.S. Patent Number (cont'd)	Inventor(s) (cont'd)
6,192,481	Deenadhayalan et al.
6,233,691	Atkinson
6,628,469	Hoyt

Published Patent Application	Inventor(s)
2003/0200473	Fung
2003/0217300	Fukumori et al.
2004/0054939	Guha et al.
2004/0068670	Suzuki et al.
2004/0068672	Fisk et al.
2004/0225903	Hirezaki et al.
2004/0250148	Tsirkel et al.

Foreign Patent Number	Inventor(s)
JP 2002-297320	Moriya
WO 03/081416	Fisk et al.

Non-Patent Documents	Author(s)
"Interplay of Energy..."	Gurumurthi et al.

Discussion of References:

U.S. Patent No. 5,691,948 to **Sakabe** discloses a disk drive (Fig. 1, col. 5, line 1) having a power save control function incorporating a measuring unit 62 in which the measurement of a time (T) of a command interval is provided. FIG. 2 illustrates a functional block diagram that shows when a command from the upper apparatus is received, the measuring unit 62 resets and starts a counter. See col. 6, ln. 33-35. When the next command is received, the counter is stopped. The measuring unit 62 measures a time (T) of the command generation interval from the count value of the counter. See col. 6, ln. 35-37. The time measurement of the command interval by the measuring unit 62 is executed a predetermined number (N) of times. After completion of the measurement (N) times, the mean value is obtained and set as a measurement time (T) into a measuring register 64. See col. 6, ln. 38-43. The measurement time (T) is also stored in the EEPROM 42 in non-volatile memory. Subsequently, a timing deciding unit 66 decides a timing *ti* (i=1, 2, 3...) for the power saving in accordance with the time (T). See col. 6, ln. 43-48. The deciding unit 66 decides four timings t1, t2, t3 & t4 that correspond to four circuit units 70, 72, 74, 76 that are divided as targets of the power savings for deciding the timings of the circuit units 70, 72, 74, 76 such as the read/write circuit, the drive head, a disk drive or a clock generating circuit. See col. 6, ln. 48-53. However, **Sakabe** powers down circuit units 70, 72, 74, 76 such as the read/write circuit, the drive head, a disk drive or a clock generating circuit, rather than "a number of said hard disk drives 80 according to the redundancy of said RAID group 82" as recited in claims 1, 8 and 20. **Sakabe** only involves a disk drive, rather than any "disk array apparatus 10 connected to an information processing apparatus 20 and comprising: a plurality of hard disk drives 80; and a controller 13 including a host interface 40 which receives a request for a data read and request for a data write from/to said hard disk drives 80 from said information processing apparatus 20, a disk interface 50 connected to said hard disk drives 80 so as to be able to communicate therewith through a communication path which performs data input/output to/from said hard disk drives 80, a memory 15, a CPU 14 which controls said host interface 40, said disk interface 50, and a time counting mechanism 16" as recited in claims 1, 8 and 20. **Sakabe** also does not provide "any access time storage section 201 which stores, upon reception of a request for a data read or request for a data write from/to said logical volume from said information processing apparatus 20, a time acquired from said time counting mechanism 16 as an access time in said memory 15 in association with an

identifier of said RAID group 82 in which said logical volume 83 is formed", or "any power saving mode execution section 202 which refers to said access time stored in said memory 15 and sets a number of said hard disk drives 80 according to the redundancy of said RAID group 82 to a power saving mode when the difference between a current time acquired from said time counting mechanism 16 and said access time exceeds a predetermined time" as recited in claims 1, 8 and 20.

U.S. Patent No. 5,809,316 to **Gouzu** discloses a power control apparatus for a computer system (Abstract) wherein the user can specify a time interval to stop driving the computer system 1. FIG. 1 shows a system-state detecting unit 2 for detecting the drive state, measuring unit for measuring a drive-stop designation time period T*off* from the time when the system 1 finishes processing to the time when the user designates drive-stop for the system 1, and for measuring a drive-start designation time period T*cont* from the time when the system 1 finishes processing to the time when the user designates drive-start for the system 1 after the system is automatically stopped. See col. 5, ln. 64 through col. 6, ln. 57. However, **Gouzu** powers down the computer system 1, rather than "a number of said hard disk drives 80 according to the redundancy of said RAID group 82" as recited in claims 1, 8 and 20. **Gouzu** only involves a computer system, rather than any "disk array apparatus 10 connected to an information processing apparatus 20 and comprising: a plurality of hard disk drives 80; and a controller 13 including a host interface 40 which receives a request for a data read and request for a data write from/to said hard disk drives 80 from said information processing apparatus 20, a disk interface 50 connected to said hard disk drives 80 so as to be able to communicate therewith through a communication path which performs data input/output to/from said hard disk drives 80, a memory 15, a CPU 14 which controls said host interface 40, said disk interface 50, and a time counting mechanism 16" as recited in claims 1, 8 and 20. **Gouzu** further does not provide "any access time storage section 201 which stores, upon reception of a request for a data read or request for a data write from/to said logical volume from said information processing apparatus 20, a time acquired from said time counting mechanism 16 as an access time in said memory 15 in association with an identifier of said RAID group 82 in which said logical volume 83 is formed", or "any power saving mode execution section 202 which refers to said access time stored in said memory 15 and sets a number of said hard disk drives 80 according to the redundancy of said RAID group 82 to a power saving mode when the difference between a current time acquired from

said time counting mechanism 16 and said access time exceeds a predetermined time" as recited in claims 1, 8 and 20.

U.S. Patent No. 5,875,120 to **Matsushima** et al. discloses an information processing system having, a CPU that is operated in a normal mode during which the CPU is driven at a relatively fast operating clock rate, and operated in a power saving mode during which the operating clock is at a lower rate or is halted. See col. 6, ln. 37-43. The system further contains a termination detector that detects a completion of a predetermined transaction between the CPU and the peripheral device, a time counter measuring a predetermined period of time after the completion of the predetermined transaction, and a power saving control which causes the CPU to enter the power saving mode until the time counted by the time counting means reaches the predetermined period of time. See col. 6, ln. 43-53. However, **Matsushima** powers down a CPU, rather than "a number of said hard disk drives 80 according to the redundancy of said RAID group 82" as recited in claims 1, 8 and 20. **Matsushima** only involves an information processing system, rather than any "disk array apparatus 10 connected to an information processing apparatus 20 and comprising: a plurality of hard disk drives 80; and a controller 13 including a host interface 40 which receives a request for a data read and request for a data write from/to said hard disk drives 80 from said information processing apparatus 20, a disk interface 50 connected to said hard disk drives 80 so as to be able to communicate therewith through a communication path which performs data input/output to/from said hard disk drives 80, a memory 15, a CPU 14 which controls said host interface 40, said disk interface 50, and a time counting mechanism 16" as recited in claims 1, 8 and 20. **Matsushima** also does not provide "any access time storage section 201 which stores, upon reception of a request for a data read or request for a data write from/to said logical volume from said information processing apparatus 20, a time acquired from said time counting mechanism 16 as an access time in said memory 15 in association with an identifier of said RAID group 82 in which said logical volume 83 is formed", or "any power saving mode execution section 202 which refers to said access time stored in said memory 15 and sets a number of said hard disk drives 80 according to the redundancy of said RAID group 82 to a power saving mode when the difference between a current time acquired from said time counting mechanism 16 and said access time exceeds a predetermined time" as recited in claims 1, 8 and 20.

U.S. Patent No. 5,918,059 to **Tavallaei** et al. discloses a system and method for a menu driven selection procedure wherein a user is given numerous options for how a server

should respond to a power switch actuation. As shown in FIG. 3, a system I/O board 108 provides the system logic for a server 12, a computing system 10, and a power supply 158. See col. 6, ln. 20-25. Menu options such as "Power Down Disable," "Power Down Gracefully" and "Power Down Absolutely" options for the user to gain control of the timing of the termination of power application by the power supply. See col. 7, ln. 43-col. 8, ln. 36. However, **Tavallaie** requires user to trigger power saving, rather than automatically executing power saving via "a power saving mode execution section 202 which refers to said access time stored in said memory 15 and sets a number of said hard disk drives 80 according to the redundancy of said RAID group 82 to a power saving mode when the difference between a current time acquired from said time counting mechanism 16 and said access time exceeds a predetermined time" as recited in claims 1, 8 and 20. In addition, **Tavallaie** powers down a server, rather than "a number of said hard disk drives 80 according to the redundancy of said RAID group 82" as recited in claims 1, 8 and 20. **Tavallaie** only involves a server, rather than any "disk array apparatus 10 connected to an information processing apparatus 20 and comprising: a plurality of hard disk drives 80; and a controller 13 including a host interface 40 which receives a request for a data read and request for a data write from/to said hard disk drives 80 from said information processing apparatus 20, a disk interface 50 connected to said hard disk drives 80 so as to be able to communicate therewith through a communication path which performs data input/output to/from said hard disk drives 80, a memory 15, a CPU 14 which controls said host interface 40, said disk interface 50, and a time counting mechanism 16" as recited in claims 1, 8 and 20.

U.S. Patent No. 5,937,433 to **Lee** et al. discloses a method of controlling a hard disk drive 66 in a battery-powered computer 62 that can effectively reduce power consumption of the hard disk drive 66. A System Management Interrupt (SMI) generator 60 generates an SMI signal when a system power failure or reboot occurs. See col. 4, ln. 51-52. When the CPU 62 receives the SMI signal it issues an acknowledgement signal (SMI_ACK) then enters an SMI routine. See col. 4 ln. 55-59. However, **Lee** powers down the hard disk drive 66, rather than "a number of said hard disk drives 80 according to the redundancy of said RAID group 82" as recited in claims 1, 8 and 20. **Lee** only involves the battery-powered computer 62, rather than any "disk array apparatus 10 connected to an information processing apparatus 20 and comprising: a plurality of hard disk drives 80; and a controller 13 including a host interface 40 which receives a request for a data read and request for a data write from/to said hard disk drives 80 from said information processing apparatus 20, a disk interface 50

connected to said hard disk drives 80 so as to be able to communicate therewith through a communication path which performs data input/output to/from said hard disk drives 80, a memory 15, a CPU 14 which controls said host interface 40, said disk interface 50, and a time counting mechanism 16" as recited in claims 1, 8 and 20. **Lee** further does not provide "any access time storage section 201 which stores, upon reception of a request for a data read or request for a data write from/to said logical volume from said information processing apparatus 20, a time acquired from said time counting mechanism 16 as an access time in said memory 15 in association with an identifier of said RAID group 82 in which said logical volume 83 is formed", or "any power saving mode execution section 202 which refers to said access time stored in said memory 15 and sets a number of said hard disk drives 80 according to the redundancy of said RAID group 82 to a power saving mode when the difference between a current time acquired from said time counting mechanism 16 and said access time exceeds a predetermined time" as recited in claims 1, 8 and 20.

U.S. Patent No. 6,052,791 to **Chen** et al. discloses a control method of a hard disk drive 16 (HDD) having a function of stopping a disk driving motor 17M after an elapse of a predetermined period of time after accessing a HDD. FIG. 2 illustrates the method which comprises steps of: monitoring a use/non-use state of a device provided with the HDD; setting an automatic-off time of the disk driving motor to a first time period when the device is in the use state, and setting the automatic-off time of the disk driving motor 17M to a second time period when the device is in the non-use state. See col. 7, ln. 46-50. A RAM 22 is read/write-controlled by the CPU 10 wherein flags and registers are provided for control of the HDD power. See col. 7, ln. 54-63. However, **Chen** powers down disk driving motor, rather than "a number of said hard disk drives 80 according to the redundancy of said RAID group 82" as recited in claims 1, 8 and 20. **Chen** only involves the device provided with the HDD, rather than any "disk array apparatus 10 connected to an information processing apparatus 20 and comprising: a plurality of hard disk drives 80; and a controller 13 including a host interface 40 which receives a request for a data read and request for a data write from/to said hard disk drives 80 from said information processing apparatus 20, a disk interface 50 connected to said hard disk drives 80 so as to be able to communicate therewith through a communication path which performs data input/output to/from said hard disk drives 80, a memory 15, a CPU 14 which controls said host interface 40, said disk interface 50, and a time counting mechanism 16" as recited in claims 1, 8 and 20. **Chen** does not provide "any access time storage section 201 which stores, upon reception of a request for a data read or

request for a data write from/to said logical volume from said information processing apparatus 20, a time acquired from said time counting mechanism 16 as an access time in said memory 15 in association with an identifier of said RAID group 82 in which said logical volume 83 is formed", or "any power saving mode execution section 202 which refers to said access time stored in said memory 15 and sets a number of said hard disk drives 80 according to the redundancy of said RAID group 82 to a power saving mode when the difference between a current time acquired from said time counting mechanism 16 and said access time exceeds a predetermined time" as recited in claims 1, 8 and 20.

U.S. Patent No. 6,192,481 to **Deenadhayalan** et al. discloses a method and system for sequencing the power of disk drives and for handling a non-responsive device in a computer system wherein the non-responsiveness may be due to a powered-down status rather than a device failure. FIG. 5 shows a method for a computer system 101 that includes a host computer 112, disk array controllers 104, 106, an array of disk drives 110, 111, a disk controller 130 and disk controller CPU 131. See col. 2, ln. 26-30. If the selected drives respond within a predetermined time period, operation is normal (Step 512), otherwise a select timeout condition is detected. See col. 6, ln. 37-41. **Deenadhayalan** only handles non-responsive RAID disk drives, rather than "refers to said access time stored in said memory 15 and sets a number of said hard disk drives 80 according to the redundancy of said RAID group 82 to a power saving mode when the difference between a current time acquired from said time counting mechanism 16 and said access time exceeds a predetermined time" as recited in claims 1, 8 and 20. **Deenadhayalan** does not provide "any access time storage section 201 which stores, upon reception of a request for a data read or request for a data write from/to said logical volume from said information processing apparatus 20, a time acquired from said time counting mechanism 16 as an access time in said memory 15 in association with an identifier of said RAID group 82 in which said logical volume 83 is formed" as recited in claims 1, 8 and 20.

U.S. Patent No. 6,233,691 to **Atkinson** discloses a system for reducing the power consumed by a computer system. FIG. 4 illustrates a method for a battery powered computer system that determines when the system is not in use by monitoring various events associated with the operation of the system. As the cache read hit rate is monitored, the system clock frequency is reduced when the rate drops below a preset threshold. See col. 4, ln. 19-24. When the TURBO input receives a logic low signal, the CPU chip 20 enters "de-turbo mode" and executes at a reduced clock speed of ½ or 1/4 . See col. 4, ln. 24-27. However, **Atkinson**

powers down the battery powered computer system, rather than "a number of said hard disk drives 80 according to the redundancy of said RAID group 82" as recited in claims 1, 8 and 20. **Atkinson** only involves a computer system, rather than any "disk array apparatus 10 connected to an information processing apparatus 20 and comprising: a plurality of hard disk drives 80; and a controller 13 including a host interface 40 which receives a request for a data read and request for a data write from/to said hard disk drives 80 from said information processing apparatus 20, a disk interface 50 connected to said hard disk drives 80 so as to be able to communicate therewith through a communication path which performs data input/output to/from said hard disk drives 80, a memory 15, a CPU 14 which controls said host interface 40, said disk interface 50, and a time counting mechanism 16" as recited in claims 1, 8 and 20. **Atkinson** also does not provide "any access time storage section 201 which stores, upon reception of a request for a data read or request for a data write from/to said logical volume from said information processing apparatus 20, a time acquired from said time counting mechanism 16 as an access time in said memory 15 in association with an identifier of said RAID group 82 in which said logical volume 83 is formed", or "any power saving mode execution section 202 which refers to said access time stored in said memory 15 and sets a number of said hard disk drives 80 according to the redundancy of said RAID group 82 to a power saving mode when the difference between a current time acquired from said time counting mechanism 16 and said access time exceeds a predetermined time" as recited in claims 1, 8 and 20.

U.S. Patent No. 6,628,469 to **Hoyt** discloses a system and method for a low power consuming disk drive unit housing multiple hard disk drives (HDD) subsystems. FIG. 5 shows how different disk platters of the HDD subsystem are selected based upon the frequency of use of the data that is stored thereon, see col. 8, ln. 41-47. More frequently accessed data is stored on the smaller, more efficient drives, wherein less frequently accessed data is stored on the larger, less efficient drives. See col. 5, ln. 39-50. The disk drive unit operates to reduce the power requirements of the disk drive unit by selectively powering the smaller/more efficient HDD subsystem the majority of the time to store frequently accessed information and not to power the multiple larger/less efficient HDD subsystems that store the less frequently accessed information. Abstract. However, **Hoyt** powers down larger/less efficient hard disk drives, rather than "a number of said hard disk drives 80 according to the redundancy of said RAID group 82" as recited in claims 1, 8 and 20. **Hoyt** only involves a low power consuming disk drive unit, rather than any "disk array apparatus 10 connected to

an information processing apparatus 20 and comprising: a plurality of hard disk drives 80; and a controller 13 including a host interface 40 which receives a request for a data read and request for a data write from/to said hard disk drives 80 from said information processing apparatus 20, a disk interface 50 connected to said hard disk drives 80 so as to be able to communicate therewith through a communication path which performs data input/output to/from said hard disk drives 80, a memory 15, a CPU 14 which controls said host interface 40, said disk interface 50, and a time counting mechanism 16" as recited in claims 1, 8 and 20. **Hoyt** does not provide "any access time storage section 201 which stores, upon reception of a request for a data read or request for a data write from/to said logical volume from said information processing apparatus 20, a time acquired from said time counting mechanism 16 as an access time in said memory 15 in association with an identifier of said RAID group 82 in which said logical volume 83 is formed", or "any power saving mode execution section 202 which refers to said access time stored in said memory 15 and sets a number of said hard disk drives 80 according to the redundancy of said RAID group 82 to a power saving mode when the difference between a current time acquired from said time counting mechanism 16 and said access time exceeds a predetermined time" as recited in claims 1, 8 and 20.

U.S. Pub. No. 2003/0200473 to **Fung** discloses a system and method comprising a plurality of server modules (SM) 54 (Fig. 1), a computer program and a control mechanism for managing power consumption and workload in the computer system and data and information servers. FIG. 10 illustrates a system 301 comprising an activity monitor 320 for identifying a level of activity indicator for at least one processor wherein each server computer 302-1 is operable in numerous modes. See pg. 12, section [0110]. The first mode having a first maximum performance level and a first power consumption rate, and a third mode having a third maximum performance level lower than the first maximum performance level and a third power consumption rate lower than said first power consumption rate. See pg. 15, section [0137]. However, **Fung** powers down server modules (SM) 54, rather than "a number of said hard disk drives 80 according to the redundancy of said RAID group 82" as recited in claims 1, 8 and 20. **Fung** only involves a system including server modules (SM) 54, rather than any "disk array apparatus 10 connected to an information processing apparatus 20 and comprising: a plurality of hard disk drives 80; and a controller 13 including a host interface 40 which receives a request for a data read and request for a data write from/to said hard disk drives 80 from said information processing apparatus 20, a disk interface 50 connected to said hard disk drives 80 so as to be able to communicate therewith through a

communication path which performs data input/output to/from said hard disk drives 80, a memory 15, a CPU 14 which controls said host interface 40, said disk interface 50, and a time counting mechanism 16" as recited in claims 1, 8 and 20. **Fung** also does not provide "any access time storage section 201 which stores, upon reception of a request for a data read or request for a data write from/to said logical volume from said information processing apparatus 20, a time acquired from said time counting mechanism 16 as an access time in said memory 15 in association with an identifier of said RAID group 82 in which said logical volume 83 is formed", or "any power saving mode execution section 202 which refers to said access time stored in said memory 15 and sets a number of said hard disk drives 80 according to the redundancy of said RAID group 82 to a power saving mode when the difference between a current time acquired from said time counting mechanism 16 and said access time exceeds a predetermined time" as recited in claims 1, 8 and 20.

U.S. Pub. No. 2003/0217300 to **Fukumori** et al. discloses a system and method for backing up a power supply for a disk array for increasing the array's availability, fault tolerance and power supply control. FIG. 3D shows a system wherein an output voltage of the power supply 230 is determined to be normal, each power supply monitor 240 sends a selecting signal to the switch SW so that operational power from the power supply 230 is distributed to various sections. When the power supply monitor 240 detects an abnormality in the output voltage of the power supply 230, the monitor 240 sends the selecting signal to the switch SW so that operational power is supplied to various sections from the backup battery 250. See pg. 5, section [0062]. However, **Fukumori** only switches to a back-up power supply, rather than "refers to said access time stored in said memory 15 and sets a number of said hard disk drives 80 according to the redundancy of said RAID group 82 to a power saving mode when the difference between a current time acquired from said time counting mechanism 16 and said access time exceeds a predetermined time" as recited in claims 1, 8 and 20. **Fukumori** does not provide "any access time storage section 201 which stores, upon reception of a request for a data read or request for a data write from/to said logical volume from said information processing apparatus 20, a time acquired from said time counting mechanism 16 as an access time in said memory 15 in association with an identifier of said RAID group 82 in which said logical volume 83 is formed" as recited in claims 1, 8 and 20.

U.S. Pub. No. 2004/0054939 to **Guha** et al. discloses a system and method for providing a power-efficient high-capacity scalable RAID storage system. FIG. 2 illustrates a

top level interconnection between the system controller 120 and shelves 110 are connected to the drives 160 by way of sticks 150 of the disk drives 160 so that each can be individually controlled in both data access and powering. See pg. 4, section [0054] and pg. 5 section [0068]. During normal operation only disk drives in use are powered on. The reduced power consumption allows the disk drives to be contained in a smaller enclosure than would conventionally be possible. See pg. 4, section [0056]. However, **Guha** powers down by sticks 150 for disk drives not in use, rather than "refers to said access time stored in said memory 15 and sets a number of said hard disk drives 80 according to the redundancy of said RAID group 82 to a power saving mode when the difference between a current time acquired from said time counting mechanism 16 and said access time exceeds a predetermined time" as recited in claims 1, 8 and 20. **Guha** does not provide "any access time storage section 201 which stores, upon reception of a request for a data read or request for a data write from/to said logical volume from said information processing apparatus 20, a time acquired from said time counting mechanism 16 as an access time in said memory 15 in association with an identifier of said RAID group 82 in which said logical volume 83 is formed" as recited in claims 1, 8 and 20.

U.S. Pub. No. 2004/0068670 to **Suzuki** et al. discloses a system and method for supplying power to a disk array device wherein the power is supplied by at least two AC inputs. FIG. 1 illustrates a series of AC inputs which are provided for the disk array device. See pg. 3, section [0053]. In each HDD housing 100, n units of AC/DC power supplies (1-1 to 1-n) 300b are connected in parallel to each of the two AC inputs, respectively. The AC/DC power supplies 300a, 300b, and a battery section 400 are mounted in each housing 100. The battery section acts as a backup power supply when the AC/DC power supplies 300a, 300b are shut off due to a power failure. A controller, when detecting a power interruption, performs a de-staging process to write unwritten data remaining in the cache to the HDD 210. See pg. 3, section [0054]. However, **Suzuki** only switches to a back-up power supply, rather than "refers to said access time stored in said memory 15 and sets a number of said hard disk drives 80 according to the redundancy of said RAID group 82 to a power saving mode when the difference between a current time acquired from said time counting mechanism 16 and said access time exceeds a predetermined time" as recited in claims 1, 8 and 20. **Suzuki** does not provide "any access time storage section 201 which stores, upon reception of a request for a data read or request for a data write from/to said logical volume from said information processing apparatus 20, a time acquired from said time counting

mechanism 16 as an access time in said memory 15 in association with an identifier of said RAID group 82 in which said logical volume 83 is formed" as recited in claims 1, 8 and 20.

U.S. Pub. No. 2004/0068672 to **Fisk** et al. discloses a disk array type storage device for replacement of a robotic type storage device, wherein a controller can effect transition of a storage device from a power-off mode to a power-on mode upon receipt of a request for reading data from or writing data to that storage device. FIG. 4 illustrates the controller 16 which effects transition of a storage device 12 from a power-on mode to a power-off mode if no read/write request is pending for that storage device 12 after a selected time period has elapsed. See pg. 2, section [0025]. However, **Fisk** powers down each disk device 12 not in use, rather than "sets a number of said hard disk drives 80 according to the redundancy of said RAID group 82 to a power saving mode when the difference between a current time acquired from said time counting mechanism 16 and said access time exceeds a predetermined time" as recited in claims 1, 8 and 20. **Fisk** also does not provide "any access time storage section 201 which stores, upon reception of a request for a data read or request for a data write from/to said logical volume from said information processing apparatus 20, a time acquired from said time counting mechanism 16 as an access time in said memory 15 in association with an identifier of said RAID group 82 in which said logical volume 83 is formed" as recited in claims 1, 8 and 20.

U.S. Pub. No. 2004/0225903 to **Hirezaki** et al. discloses a power control method of a storage system wherein power to a storage device is turned on and the storage device can accept a data input and output request, the storage device transmits a power-on request for turning the power on for the information processing device. When the storage device accepts a stop-power instruction, it transmits a stop-power request to halt power to the information processing device. FIG. 2 illustrates a block diagram showing the structure of host interface (SVP) 250 having a receiving part 251, a transmitting part 252 and a detecting part 253. See pg. 3, section [0035]. The receiving part 250 functions as to receive the power-on/power-stop requests from storage device 100 through LAN 400. See pg. 4, section [0056] and [0057]. **Hirezaki** does not provide "a power saving mode execution section 202 which refers to said access time stored in said memory 15 and sets a number of said hard disk drives 80 according to the redundancy of said RAID group 82 to a power saving mode when the difference between a current time acquired from said time counting mechanism 16 and said access time exceeds a predetermined time" as recited in claims 1, 8 and 20. **Hirezaki** also does not provide "any access time storage section 201 which stores, upon reception of a

request for a data read or request for a data write from/to said logical volume from said information processing apparatus 20, a time acquired from said time counting mechanism 16 as an access time in said memory 15 in association with an identifier of said RAID group 82 in which said logical volume 83 is formed" as recited in claims 1, 8 and 20.

U.S. Pub. No. 2004/0250148 to **Tsirkel** et al. discloses a tiered secondary memory architecture for the reduction of power consumption in a portable computer. FIG. 2 illustrates a method of optimizing the power consumption of a computer. See pg. 1, section [0017]. Following the system power-up 205, the applications run by the system are tracked in an Operation 210. An Operation 220 then determines if the system is in a power optimization mode. If the system is in a power optimization mode, then the applications that have a high utilization are moved to the mini-HDD 170 in Operation 230. However, **Tsirkel** powers down mini-HDD 170, rather than "a number of said hard disk drives 80 according to the redundancy of said RAID group 82" as recited in claims 1, 8 and 20. **Tsirkel** only involves a portable computer, rather than any "disk array apparatus 10 connected to an information processing apparatus 20 and comprising: a plurality of hard disk drives 80; and a controller 13 including a host interface 40 which receives a request for a data read and request for a data write from/to said hard disk drives 80 from said information processing apparatus 20, a disk interface 50 connected to said hard disk drives 80 so as to be able to communicate therewith through a communication path which performs data input/output to/from said hard disk drives 80, a memory 15, a CPU 14 which controls said host interface 40, said disk interface 50, and a time counting mechanism 16" as recited in claims 1, 8 and 20. **Tsirkel** does not provide "any access time storage section 201 which stores, upon reception of a request for a data read or request for a data write from/to said logical volume from said information processing apparatus 20, a time acquired from said time counting mechanism 16 as an access time in said memory 15 in association with an identifier of said RAID group 82 in which said logical volume 83 is formed", or "any power saving mode execution section 202 which refers to said access time stored in said memory 15 and sets a number of said hard disk drives 80 according to the redundancy of said RAID group 82 to a power saving mode when the difference between a current time acquired from said time counting mechanism 16 and said access time exceeds a predetermined time" as recited in claims 1, 8 and 20.

Japanese Reference JP 2002-297320 to **Moriya** discloses a load monitoring part 12 for a disk controller 1 that transmits load information based on the writing/reading request of

data to a CPU 1. FIG. 1 illustrates a system wherein the CPU 1 having received the information detects that the load becomes equal to or smaller than a threshold, the disk array device 10 is shifted to an energy saving mode. In this energy saving mode, power feeding to HDDs 22 to 24 except a HDD 21 is stopped to reduce power to be consumed. See English Abstract and sections [0007] and [0012] of the translated specification. However, **Moriya** shifts to power saving mode when a load which becomes equal to or smaller than a threshold, rather than when "the difference between the time acquired from the time counting mechanism and the access time exceeds a predetermined time" as recited in claims 1, 8 and 20. As such, **Moriya** does not provide "a power saving mode execution section 202 which refers to said access time stored in said memory 15 and sets a number of said hard disk drives 80 according to the redundancy of said RAID group 82 to a power saving mode when the difference between a current time acquired from said time counting mechanism 16 and said access time exceeds a predetermined time" as recited in claims 1, 8 and 20. **Moriya** does not involve any "disk array apparatus 10 connected to an information processing apparatus 20 and comprising: a plurality of hard disk drives 80; and a controller 13 including a host interface 40 which receives a request for a data read and request for a data write from/to said hard disk drives 80 from said information processing apparatus 20, a disk interface 50 connected to said hard disk drives 80 so as to be able to communicate therewith through a communication path which performs data input/output to/from said hard disk drives 80, a memory 15, a CPU 14 which controls said host interface 40, said disk interface 50, and a time counting mechanism 16" as recited in claims 1, 8 and 20. **Moriya** also does not provide "any access time storage section 201 which stores, upon reception of a request for a data read or request for a data write from/to said logical volume from said information processing apparatus 20, a time acquired from said time counting mechanism 16 as an access time in said memory 15 in association with an identifier of said RAID group 82 in which said logical volume 83 is formed" as recited in claims 1, 8 and 20.

PCT Application WO 03/081416 to **Fisk** et al. discloses a disk array type storage device for replacement of a robotic type storage device, wherein a controller can effect transition of a storage device from a power-off mode to a power-on mode upon receipt of a request for reading data from or writing data to that storage device. The controller also effects transition of a storage device from a power-on mode to a power-off mode if no read/write request is pending for that storage device after a selected time period has elapsed. See pg. 9, ln. 9 through pg. 10 ln. 3. However, **Fisk** does not provide "a power saving mode

execution section 202 which refers to said access time stored in said memory 15 and sets a number of said hard disk drives 80 according to the redundancy of said RAID group 82 to a power saving mode when the difference between a current time acquired from said time counting mechanism 16 and said access time exceeds a predetermined time" as recited in claims 1, 8 and 20. **Fisk** does not provide "any access time storage section 201 which stores, upon reception of a request for a data read or request for a data write from/to said logical volume from said information processing apparatus 20, a time acquired from said time counting mechanism 16 as an access time in said memory 15 in association with an identifier of said RAID group 82 in which said logical volume 83 is formed" as recited in claims 1, 8 and 20.

"Interplay of Energy and Performance ..." to **Gurumurthi** et al. relates to the proportionality or equivalence between energy consumed by a disk array and the performance of the disk array. Evaluated are four metrics, total energy consumed over all the requests (E*tot*), average energy consumption per I/O request (E), response-time per I/O request (T), and energy-response-time product (ExT). See pg. 4, section 4.3. However, **Gurumurthi** does not provide "a power saving mode execution section 202 which refers to said access time stored in said memory 15 and sets a number of said hard disk drives 80 according to the redundancy of said RAID group 82 to a power saving mode when the difference between a current time acquired from said time counting mechanism 16 and said access time exceeds a predetermined time" as recited in claims 1, 8 and 20. **Gurumurthi** also does not provide "any access time storage section 201 which stores, upon reception of a request for a data read or request for a data write from/to said logical volume from said information processing apparatus 20, a time acquired from said time counting mechanism 16 as an access time in said memory 15 in association with an identifier of said RAID group 82 in which said logical volume 83 is formed" as recited in claims 1, 8 and 20.

Conclusion

Based on the results of the comprehensive prior art search as discussed above, Applicants contend that the method or system as recited in independent claims 1, 8 and 20, especially the features of "a power saving mode execution section 202 which refers to said access time stored in said memory 15 and sets a number of said hard disk drives 80 according to the redundancy of said RAID group 82 to a power saving mode when the difference between a current time acquired from said time counting mechanism 16 and said access time

exceeds a predetermined time" and "a access time storage section 201 which stores, upon reception of a request for a data read or request for a data write from/to said logical volume from said information processing apparatus 20, a time acquired from said time counting mechanism 16 as an access time in said memory 15 in association with an identifier of said RAID group 82 in which said logical volume 83 is formed" as recited in claims 1, 8 and 20 are patentably distinct from the cited prior art references.

The disk array apparatus 10 of the invention (for example, the embodiment depicted in Figs. 1-2), as now recited in claim 1, connected to an information processing apparatus 20 so as to be able to communicate therewith, comprising: a plurality of hard disk drives 80; and a controller 13 (Fig. 3) constructed by including a host interface 40 which receives a request for a data read and request for a data write from/to said hard disk drives 80 from said information processing apparatus 20, a disk interface 50 connected to said hard disk drives 80 so as to be able to communicate therewith through a communication path which performs data input/output to/from said hard disk drives 80, a memory 15, a CPU 14 which controls said host interface 40, said disk interface 50, and a time counting mechanism 16. A logical volume 83 is formed in a RAID group 82 with redundancy made up of a plurality of said hard disk drives 80, said disk array apparatus 10 comprising: an access time storage section 201 which stores, upon reception of a request for a data read or request for a data write from/to said logical volume from said information processing apparatus 20, a time acquired from said time counting mechanism 16 as an access time in said memory 15 in association with an identifier of said RAID group 82 in which said logical volume 83 is formed; and a power saving mode execution section 202 which refers to said access time stored in said memory 15 and sets a number of said hard disk drives 80 according to the redundancy of said RAID group 82 to a power saving mode when the difference between a current time (p. 17, line 28) acquired from said time counting mechanism 16 and said access time exceeds a predetermined time (e.g., a power saving wait time 302: 20 minutes in Fig. 3; p. 17, lines 10-19; p. 18, lines 1-5).

The invention as now recited in claim 8, is directed to the disk array apparatus of claim 1 having a plurality of first hard disk drives which perform data transmission/reception according to a first interface standard; a plurality of second hard disk drives which perform data transmission/reception according to a second interface standard having a shorter life than said first hard disk drives, and further including a power saving start time storage section 1303 (Fig. 13) which stores the second time acquired from said time counting mechanism as

a power saving start time in said memory 15 in association with the identifier of said RAID group 82 when said first or second hard disk drives 80 are set to a power saving mode by said power saving mode execution section 203/1303; and a power saving mode cancellation section 205/1304 which refers to said power saving start time and cancels the power saving mode of said first or second hard disk drives in a power saving mode when the difference between said power saving start time and a third time acquired from said time counting mechanism 16 exceeds a predetermined time.

The invention as now recited in claim 20, is directed to a method implemented by the disk array apparatus of claim 8.

In view of all the above, clear and distinct differences as discussed exist between the present invention as now claimed and the prior art references, Applicant respectfully contends that the prior art references cannot anticipate the present invention or render the present invention obvious. Rather, the present invention as a whole is distinguishable, and thereby allowable over the prior art.

Favorable consideration of this application is respectfully solicited. Should there be any outstanding issues requiring discussion that would further the prosecution and allowance of the above-captioned application, the Examiner is invited to contact the Applicant's undersigned representative at the address and telephone number indicated below.

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